June 27, 2006

MEMORANDUM TO: Jared S. Wermiel, Deputy Director
Division of Safety Systems

FROM: Michael L. Scott, Chief /***RA***/
Safety Issues Resolution Branch
Division of Safety Systems

SUBJECT: STAFF OBSERVATIONS OF TESTING FOR GENERIC SAFETY ISSUE 191 DURING APRIL 27, 2006 TRIP TO FAUSKE & ASSOCIATES

On April 27, 2006, the NRC staff traveled to Fauske & Associates in Burr Ridge, Illinois, to observe generic testing associated with the resolution of Generic Safety Issue 191 (GSI-191). The primary objective of the trip was to observe in-progress alternate chemical buffer testing being performed for the Pressurized Water Reactor (PWR) Owners Group. The trip was coordinated with a separate visit to the Alion Hydraulics Laboratory (ML061720514) to observe preparations for testing the proposed top-hat replacement strainers for the San Onofre Nuclear Generating Station and other test activities underway at the facility. The participating NRC staff members were Ralph Architzel of NRR/DSS/SSIB, Paul Klein and Matt Yoder of NRR/DCI/CSGB, and Paulette Torres of RES/DET. The staff interacted with vendor personnel from Westinghouse and Fauske & Associates.

The objective of the PWR Owner's Group sponsored work at the Fauske & Associates facility is to identify a replacement buffering agent for sodium hydroxide (NaOH) or trisodium phosphate (TSP) in order to reduce the potential for chemical precipitate generation in a postulated post loss of coolant accident (LOCA) containment pool environment. The alternate buffer project started in February 2006 and is projected to continue through June 2006. Alternate buffer chemicals being evaluated included sodium metaborate tetrahydrate, sodium tripolyphosphate and sodium gluconate. The evaluations also include the existing buffers (i.e., sodium tetraborate decahydrate, NaOH, and TSP). Key elements of the multi-phase buffer testing approach include:

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- dissolution testing in water and in boric acid solution as a function of temperature
- assessment of the quantity of candidate material needed to buffer representative boric acid solutions
- investigation of precipitate formation upon addition of aluminum or calcium salt to various buffered solutions
- determination of the effects of elevated temperature storage on potential alternate buffers
- evaluation of aluminum and steel corrosion in the buffered solutions
- determination of the solubility limit of boric acid in solutions of the various candidate buffering agents

At the time of the staff visit, dissolution testing, pH buffering testing, precipitation testing, and boric acid solubility testing had been completed. Corrosion tests (aluminum, steel) and elevated temperature storage tests were in progress. Sodium gluconate did not meet the solution pH requirements during dissolution testing and was therefore removed from the candidate list for alternate buffers. The amount of buffer chemical needed to adjust a 2500 ppm borated solution to a pH of either 7.5 or 8 was measured. In general, less sodium metaborate, approximately the same amount of sodium tetraborate, and more sodium tripolyphosphate was needed (relative to TSP) to adjust the borated solution to a 7.5 pH.

The staff observed ten graduated cylinders that contained solution buffered to either a 7.5 pH (sodium tripolyphosphate) or 8 pH (NaOH, TSP, sodium metaborate, sodium tetraborate). Either 400 ppm dissolved calcium (calcium chloride addition) or 1000 ppm dissolved aluminum (aluminum nitrate nonahydrate) had been added to the buffered solutions at a temperature representative of a post-LOCA containment pool to investigate the potential for precipitate formation. These solutions had cooled to room temperature and any precipitates had settled for approximately two to three weeks prior to the staff's visit. Overall, the graduated cylinders with the sodium tripolyphosphate solution contained the least amount of precipitate. For calcium addition, the greatest amount of precipitate appeared to have formed in the TSP solution. The precipitate formed by calcium addition to the sodium metaborate and sodium tetraborate solutions had a white crystalline appearance. Upon aluminum addition, the greatest amount of precipitate appeared to have formed in the NaOH buffered solution.

Following the lab tour, general discussion concluded with remaining plans for the alternate buffer test program. Based on staff observations and discussions with the representatives from Westinghouse and Fauske & Associates, the staff provided some feedback related to the alternate buffer tests. The staff encouraged continued investigation of alternate buffers since they have the potential to provide licensees a means to mitigate chemical effects. Although the tests the staff observed appeared to provide valuable information, the staff's overall impression was that more comprehensive work would be needed to develop a technical basis for a licensee to switch to a new buffer. Specific items the staff mentioned for consideration included:

- understanding the amount of precipitate formed as a function of dissolved aluminum or calcium concentration
- understanding the potential interactions between alternate buffers and other containment materials (e.g., by performing an integrated test)
- investigation of temperature effects on precipitate formation

- evaluation of the buffering capacity of the various solutions given possible formation of nitric and hydrochloric acids during the ECCS mission time
- the need for buffer storage tests to be performed in conditions representative of actual plant temperature and humidity conditions

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